SECTION 308

PORTLAND CEMENT-TREATED BASES

SECTION 308.10 PORTLAND CEMENT-TREATED BASE, CENTRAL PLANT METHOD

308.11 Description. This work shall consist of constructing one or more courses of a mixture of water, portland cement and aggregate or soil on a prepared subgrade in accordance with these specifications and in conformity with the lines, grades, thicknesses and typical cross sections shown on the plans or established by the engineer.

308.12 Material. All material shall conform to Division 1000, Materials Details, and specifically as follows:

Item	Section
Liquid Asphalt (RC-70, MC-30 or MC-70)	1015
Portland Cement, Type I	1019
Water	1070

Soil or Aggregate - The gradation and other requirements will be specified in the contract.

The grade of liquid asphalt will be specified in the contract.

308.12.1 Representative samples of the soil or aggregate shall be obtained by the contractor in the presence of the engineer in time to permit delivery to the Central Laboratory for testing at least seven weeks prior to the preparation of any of the mixture on the project. The cement content to be used will be designated by the engineer.

308.13 Equipment.

308.13.1 Plant. The soil or aggregate, cement and water shall be thoroughly and uniformly mixed in the specified proportions by an approved central plant of the batch or continuous flow type. The plant shall be equipped with weighing or metering devices capable of controlling the cement content within 0.5 percentage point of that specified. The plant shall be calibrated by the contractor in the presence of and subject to the approval of the engineer. A portable beam scale of 500-pound (200 kg) capacity, together with ten 50-pound (20 kg) standard test weights and a 55-gallon (200 liter) container, shall be made available at the plant by the contractor at all times for checking the accuracy of the equipment. The mixing equipment shall be capable of producing at least 100 tons (90 Mg) per hour for contracts totaling 30,000 square yards (25,000 m^2) or less, and at least 200 tons (180 Mg) per hour for contracts totaling more than 30,000 square yards (25,000 m^2).

308.13.2 Spreaders. Spreaders shall be equipped with adjustable screeds to maintain the required width, thickness and cross section, and shall be sufficient in number and capacity to handle production of the plant. Spreaders propelled by trucks will not be permitted.

308.13.3 Distributors. Pressurized distributors in satisfactory condition shall be capable of maintaining the specified moisture content of the mixture on the roadway during construction.

308.13.4 Rollers. Rollers shall be capable of producing the required density and finish. Tamping rollers shall have wedge or cone shaped feet, and may be propelled by a separate unit. All other types of rollers shall be self-propelled.

308.13.5 Miscellaneous Equipment. A spike-tooth harrow or similar device shall be used as necessary to minimize compaction planes. A broom drag shall be provided for use in final surface finishing. Miscellaneous equipment shall be propelled by pneumatic-tire vehicles.

308.14 Field Laboratory. When authorized by the engineer, the contractor shall provide a Type 2 Field Laboratory meeting the requirements of Sec 601. Payment for the laboratory will be made as provided in Sec 601.

308.15 Construction Requirements.

308.15.1 Subgrade. All portions of the roadbed, upon which the cement-treated base is to be constructed, shall be shaped to within a roughly compensating maximum deviation of 1/2 inch (13 mm) of the grade and cross section shown on the plans. Any soft or yielding subgrade shall be removed, and backfilled with approved material. If such correction is necessary as a result of the contractor's negligence or of his operations, repairs shall be made at the contractor's expense.

308.15.2 Borrow. The contractor shall excavate the borrow area in such manner that the material obtained from the deposit complies with the requirements of the contract. The borrow area may include layers that will require mixing to produce acceptable material. It may also contain deposits that are to be avoided as they may not be acceptable for use in the cement-treated base.

308.15.3 Mixing. Water shall be added during the mixing operation as required to provide the quantity of moisture specified for compaction. However, water shall not be added to the mixture before the soil and cement have been mixed sufficiently to prevent the formation of cement balls. The moisture content specified for the total material of the mixture shall be determined by tests on samples obtained during construction. Until such tests can be made, the optimum moisture content determined by the Central Laboratory shall be used. When expelled from the mixer, at least 80 percent of the cement-treated mixture, exclusive of gravel, stone and lumps of bituminous material shall pass the No. 4 (4.75 mm) sieve, and shall generally contain no clods of soil larger than one inch (25 mm). However, if clods are at or above their optimum moisture content, their maximum permissible size shall be 1 1/2 inches (38 mm), and the minimum passing the No. 4 (4.75 mm) sieve, exclusive of gravel, stone or lumps of bituminous material, shall be 70 percent.

308.15.4 Hauling and Spreading. The cement-treated mixture shall be hauled in tight vehicles free from foreign matter. The subgrade shall be sprinkled immediately before placing the mixture. The mixture shall be simultaneously deposited and spread on the subgrade. Not more than 60 minutes shall elapse between the mixing and spreading. The mixture shall not be placed on frozen subgrade nor shall it be placed unless the ambient temperature is at least 40 F (5 C) and rising.

308.15.4.1 Edges of the cement-treated mixture against which adjacent lanes will be spread shall remain uncompacted for a width not to exceed 18 inches (450 mm) until the adjacent mixture is spread, but shall not remain exposed for more than 45 minutes. If adjacent lanes cannot be placed within that time, the edge of the previously placed mixture shall be cut back to a point where it meets the proper line and grade, and trimmed to a vertical face parallel to the centerline of the roadway prior to resuming spreading operations.

308.15.4.2 To form a transverse construction joint, the end of a complete portion shall be cut back to a point where it meets proper grade and crown, and shall be trimmed to a vertical face at right angles to the centerline for the full depth and width of the cement-treated base.

308.15.5 Compacting. Compacting shall start immediately after spreading, and shall continue until not less than 95 percent of standard maximum density has been attained.

308.15.5.1 During compacting operations, the percentage of moisture in the total material of the mixture shall not vary from the optimum moisture content as determined by the standard compaction test by more than 2.0 percentage points. If the moisture falls more than 2.0 percentage points below optimum, the contractor shall add sufficient water with pressure distributors to maintain the moisture within the tolerance. If the moisture content at any time during construction exceeds the upper limit, the mixture may be dried by aeration until the moisture content has been satisfactorily reduced, and then compacted and finished. If this cannot be accomplished within the time limits specified in Sec 308.15.6, the entire affected area shall be removed and replaced, or shall be corrected by mixing in an additional 50 percent of the original cement content and completing the operations, at the contractor's expense for both the processing and additional cement required.

308.15.5.2 The Standard Compaction Test will be performed at the start of the compacting operation, in accordance with AASHTO T 99, Method C, replacing any material retained on the 3/4-inch (19.0 mm) sieve, as provided therein. The field density of the portland cement-treated material after compaction will be determined in accordance with AASHTO T 191 or T 205, using the total material or T 238, Method B Direct Transmission, for wet density. The volume of the test hole may be reduced as necessary to accommodate available testing equipment. If nuclear density methods are used, moisture content will be determined in accordance with AASHTO T 239, except that a moisture correction factor will be determined in accordance with MoDOT Test Method T35. The calculated density obtained in a field density test will be compared with the maximum density as established by the Standard Compaction Test to determine the percent compaction attained.

308.15.5.3 To avoid the necessity for frequent field density tests, the contractor shall, near the beginning of the work, build a test section not less than 500 feet (150 m) long, for the full width of the proposed treatment, for the purpose of establishing the procedure required to attain the density specified in Sec 308.15.5. For the remainder of the project, the portland cement-treated base may be assumed to meet the specified density requirements if the compacting procedure established by the test section has been used, and the moisture content of the total material during compacting operations has been maintained within 2.0 percentage points of optimum, as determined by the Standard Compaction Test, and there is no visible evidence of further consolidation. A new test section shall be built to establish a revised compacting procedure when there is an appreciable change in gradation or type of material, a change in source of material, a revision in the cement content, when density tests show inadequate compaction, or when in the judgment of the engineer a revised procedure is required.

308.15.6 Shaping and Finishing. Should the surface of the cement-treated base require shaping after the mixture has been compacted, harrowing may be necessary to minimize formation of compaction planes. The surface of the cement-treated base shall be kept moist during shaping and finishing operations. Surface compacting and finishing may be varied as necessary to produce, within five hours after the mixture is placed on the subgrade, a smooth, tightly knit surface. If the surface of the hardened cement-treated base crumbles or loosens under construction and public traffic, the loose material shall, at the contractor's expense, be removed and replaced with an equal thickness of approved bituminous mixture prior to placement of subsequent bituminous courses.

308.15.7 Protective Cover. The contractor shall apply a protective cover of bituminous material in accordance with Sec 408, Prime Coat, not later than the next day after finishing any portion. The minimum air and surface temperature restrictions of Sec 408 will not apply for this operation. The finished surface of the cement-treated base shall be kept continuously moist until the protective cover is applied. Sand blotter shall be applied when directed by the engineer as necessary to maintain local traffic. This protective cover may serve as a prime; however, it may be necessary to apply additional prime before constructing a surface course. At any time within seven days after placement, when the air temperature is expected to be 32 F (0 C) or below, the cement-treated base shall be protected against freezing with either a 3-inch (75 mm) thickness of loose soil or a 6-inch (150 mm) thickness of loose straw. Only pneumatic tire equipment required for applying the bituminous protective cover, sand blotter, and material used to protect against freezing will be permitted on the cement-treated base for seven days following completion, except where necessary to maintain local traffic. The contractor shall, at the contractor's expense, maintain completed portions in a satisfactory condition until acceptance of the work.

308.16 Method of Measurement.

308.16.1 Measurement of cement will be made to the nearest barrel (100 kg). Measurement of bulk cement will be made by weighing (determining the mass of) each truck load on scales conforming to the requirements of Sec 310.4.3. Hopper scales calibrated in a similar manner may be used in lieu of the vehicle scales. If bagged cement is used, the net weight (mass) as packaged by the manufacturer will be used for measurement.

308.16.2 Measurement of the weight (mass) of soil or aggregate, to the nearest ton (megagram), will be determined by subtracting the weight (mass) of the cement from the weight (mass) of the mixture. The weight (mass) of the mixture will be determined from batch weights (masses) if a batch-type plant is used, and will be determined by weighing (determining the mass of) each truck load on scales conforming to the requirements of Sec 310.4.3 if a continuous-type plant is used. No deduction will be made for the weight (mass) of water in the mixture.

308.17 Basis of Payment. The accepted quantities of portland cement-treated base will be paid for at the unit price for each of the pay items included in the contract. Payment for bituminous material and sand blotter for protective cover will be made in accordance with Sec 408.

308.17.1 No direct payment will be made for water used in performing this work.

SECTION 308.20 PORTLAND CEMENT-TREATED BASE, ROAD MIX METHOD

308.21 Description. This work shall consist of constructing one or more courses of a mixture of water, portland cement and soil or other designated material on a prepared subgrade in accordance with these specifications, and in conformity with the lines, grades, thicknesses and typical sections shown on the plans or established by the engineer.

308.22 Material. All material shall conform to Division 1000, Materials Details, and specifically as follows:

Item	Section
Liquid Asphalt (RC-70, MC-30 or MC-70)	1015
Portland Cement, Type I	1019
Water	1070

Soil or Other Designated Material - The gradation and other requirements will be specified in the contract.

The grade of liquid asphalt will be specified in the contract.

308.22.1 It may be necessary to test samples of the material prior to mixing. If so, representative samples shall be obtained by the contractor in the presence of the engineer in time to permit delivery to the Central Laboratory for testing at least seven weeks prior to the preparation of any of the mixture on the project. The cement content to be used will be designated by the engineer.

308.23 Equipment.

308.23.1 Mixers. Cement-treated base shall be mixed with an approved machine which may be (1) a single-pass mixer which pulverizes the material in place and mixes it with cement and water, (2) a mixer which elevates the material from a windrow into a pugmill and mixes it with cement and water, or (3) a multiple-pass rotary mixer capable of mixing to the full depth of treatment. Supplementary equipment for pulverizing the material prior to the addition of cement may be used, if needed. Machines which add water to the mixture before the cement has been mixed with the soil will not be approved.

308.23.2 Distributors. Except when water is applied directly through the mixer, pressurized distributors in satisfactory condition shall be used to obtain and maintain the specified moisture content of the mixture.

308.23.3 Rollers. Rollers shall be capable of producing the required density and finish. Tamping rollers shall have wedge or cone shaped feet, and may be propelled by a separate unit. All other types of rollers shall be self-propelled.

308.23.4 Miscellaneous Equipment. A spike-tooth harrow or similar device shall be used as necessary to minimize compaction planes. A broom drag shall be provided for use in final surface finishing. Miscellaneous equipment shall be propelled by pneumatic-tire vehicles.

308.24 Field Laboratory. When authorized by the engineer, the contractor shall provide a Type 2 Field Laboratory meeting the requirements of Sec 601. Payment for the laboratory will be made as provided in Sec 601.

308.25 Construction Requirements.

308.25.1 Roadbed Preparation. Vegetation shall be removed from the material to be processed and shall be disposed of by the contractor. All portions of the roadbed, upon which the cement-treated base is to be constructed, shall be shaped to within a roughly compensating maximum deviation of 1/2 inch (15 mm) of the grade and cross section shown on the plans. Shaping operations may involve roadbed scarifying and shifting of material to correct excessive or deficient crown and obtain correct superelevation. Pre-pulverization of the base material may be necessary to meet the gradation requirements specified in the contract. Any soft, yielding or unsuitable subgrade shall be removed and backfilled with approved material. If such corrective action is necessary as a result of the contractor's negligence or operations, repairs shall be made at the contractor's expense.

308.25.2 Borrow. The contractor shall excavate the borrow area in such manner that the material obtained from the deposit complies with the requirements of the contract. The borrow area may include layers that will require mixing to produce acceptable material. It may also contain deposits that are to be avoided as they may not be acceptable for use in the cement-treated base.

308.25.3 Application of Cement. The designated quantity of cement shall be uniformly distributed over the material to be treated. When cement is spread, the moisture content of the material to be processed shall not exceed the optimum moisture content of the cement-treated mixture. Cement shall be applied only to such an area that all operations can be continuous and mixing started within 3 hours of such application. Spread cement that has been displaced shall be replaced or redistributed before mixing is started. Cement shall not be applied when the material to be processed is frozen and unless the ambient temperature is at least 40 F (5 C) and rising.

308.25.3.1 Bulk cement shall be handled and spread with equipment capable of applying the proper quantity in an approved manner. Bagged cement shall be emptied in a regular pattern and spread uniformly over the roadbed or on the windrow. Care shall be taken when spreading cement on windrows to avoid spillage on the subgrade.

308.25.4 Mixing. The cement, base material and water shall be mixed to form a homogeneous mixture free of segregation and having a uniform moisture content. Following moist mixing, at least 80 percent of the cement-treated mixture, exclusive of gravel, stone or lumps of bituminous material, shall pass the No. 4 (4.75 mm) sieve, and shall generally contain no clods of soil larger than one inch (25 mm). However, if clods are at or above their optimum moisture content, their maximum permissible size shall be 1 1/2 inches (38 mm), and the minimum passing the No. 4 (4.75 mm) sieve, exclusive of gravel, stone or lumps of bituminous material, shall be 70 percent. After the mixing of water, cement and base material has been completed, and during the succeeding operations, the percentage of moisture in the total material of the mixture shall not vary from the optimum moisture content as determined by the standard compaction test by more than 2.0 percentage points. The moisture content specified for the total material of the mixture shall be determined by tests on samples obtained during construction. Until such tests can be made, the optimum moisture content determined by the Central Laboratory shall be used. If the moisture content at any time during the construction exceeds the tolerance given, the mixture may be dried by aeration until the moisture content has been satisfactorily reduced. If this cannot be accomplished, the entire affected area shall be removed and replaced, or shall be corrected by mixing in an additional 50 percent of the original cement content and completing the operations, at the contractor's expense for both the processing and additional cement required.

308.25.4.1 When multiple-pass rotary mixers are used, the cement and base material shall be mixed until a homogeneous mixture is obtained before water is added. Each application of water during the mixing operations shall be at least partially incorporated into the mixture.

308.25.5 Compacting. Prior to the beginning of compacting, the mixture shall be in a loose condition for its full depth. Compacting shall start immediately after mixing, and shall continue until not less than 95 percent of standard maximum density has been attained. During compacting operations, shaping and harrowing may be required to attain uniform compaction and the specified grade and cross section. No mixture shall remain undisturbed for more than 30 minutes during the mixing and compacting operations. The Standard Compaction Test and density determinations will be performed in accordance with Sec 308.15.5.2. The construction of a test section and the compacting procedure shall be performed in accordance with Sec 308.15.5.3.

308.25.6 Shaping and Finishing. Shaping and finishing of the surface of cement-treated base shall be performed in accordance with Sec 308.15.6.

308.25.6.1 The thickness of the cement-treated mixture will be determined from measurements through the finished base at approximately 500-foot (150 m) intervals. If the average thickness shown by the measurements made in one day's construction is not within

1/2 inch (15 mm) of that specified, the contractor will be required to reconstruct that day's work at the contractor's expense. The contractor will be required, at the contractor's expense, to reconstruct any areas which vary more than 3/4 inch (19 mm) from the specified thickness. Low or thin areas shall not be remedied by adding a layer to the completed work.

308.25.7 Construction Joint. To form a transverse construction joint, the end of a completed portion shall be cut back to a point where it meets proper grade and crown and shall be trimmed to a vertical face at right angles to the centerline for the full depth and width of the cement-treated base.

308.25.8 Protective Cover. The contractor shall apply a protective cover in accordance with the requirements of Sec 308.15.7.

308.26 Method of Measurement.

308.26.1 Measurement of cement will be made to the nearest barrel (100 kg). Measurement of bulk cement will be made by weighing (determining the mass of) each truck load on scales conforming to the requirements of Sec 310.4.3. Hopper scales calibrated in a similar manner may be used in lieu of the vehicle scales. If bagged cement is used, the net weight (mass) as packaged by the manufacturer will be used for measurement.

308.26.2 Authorized borrow material will be measured and paid for in accordance with Sec 203.

308.27 Basis of Payment. The accepted quantities of portland cement-treated base will be paid for at the unit price for each of the pay items included in the contract. Payment for bituminous material and sand blotter for protective cover will be made in accordance with Sec 408.

308.27.1 No direct payment will be made for water used in performing this work.